THIS OPINION WAS NOT WRITTEN FOR PUBLICATION

The opinion in support of the decision being entered today (1) was not written for publication in a law journal and (2) is not binding precedent of the Board.

Paper No. 38

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte MEHRDAD M. MOSLEHI

Appeal No. 1999-1666
Application 08/847,319[1]

ON BRIEF

Before HAIRSTON, FLEMING and GROSS, Administrative Patent Judges.

HAIRSTON, Administrative Patent Judge.

DECISION ON APPEAL

This is a decision on appeal under 35 U.S.C. § 134 from

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[1] Application for patent filed April 23, 1997. According to the appellant, this application is a continuation of Application No. 08/332,528, filed October 31, 1994, now abandoned.

the examiner's final rejection of claims 4, 47-52, and 54 which represent all of the claims remaining in the application.

Appellant's After Final Amendment (Paper No. 28) to claim 4 was entered by the examiner (Paper No. 30).

The invention pertains to the fabrication of microelectronics devices and integrated circuits. More specifically, the invention relates to a method of directly doping a semiconductor wafer by exposing a surface of the wafer to a non-ionized process medium in order to directly dope at least a portion of the surface of the wafer. The non-ionized process medium comprises a dopant gas having an organic compound of a dopant species. The organic compound in the dopant gas is a material selected from the group consisting of $(CH_3)_3B$, $(C_2H_5)_3B$, $(OCH_3)_3B$, $(CH_3S)_2BCH_3$, $(CH_3)_2BN(CH_3)_2$, $(CH_3)_2BOCH_3$ and $CH_3SB(CH_3)_2$. The process includes the step of heating the wafer, thermally activating the dopant species and causing solid state diffusion of the dopant species into the semiconductor wafer surface. At least portions of the semiconductor wafer surface are doped with p-type doping, where the dopant species is boron.

Claim 4 is illustrative of the claimed invention, and reads as follows:

4. A direct doping method for semiconductor wafers, comprising the steps of:

providing a semiconductor wafer having a surface;

exposing said surface of said wafer to a non-ionized process medium in order to directly dope at least a portion of said surface of said wafer, wherein said process medium comprises a dopant gas, and wherein said dopant gas comprises an organic compound of a dopant species; and

heating said wafer, thermally activating said dopant species and causing solid state diffusion of said dopant species into said semiconductor wafer surface, wherein said doping is performed without the presence of plasma, wherein said organic compound is a material selected from the group consisting of $(CH_3)_3B$, $(C_2H_5)_3B$, $(OCH_3)_3B$, $(CH_3S)_2BCH_3$, $(CH_3)_2BN(CH_3)_2$, $(CH_3)_2BOCH_3$, and $CH_3SB(CH_3)_2$ in order to dope at least portions of said surface of said semiconductor wafer with p type doping, wherein said dopant species is boron, wherein said semiconductor wafer is heated to a temperature in the range of 650°C and 1150°C.

The prior art relied upon by the examiner as evidence of obviousness are:

Melas et al. (Melas)	4,734,514	Mar. 29, 1988
Bohling et al. (Bohling)	4,904,616	Feb. 27, 1990
Kiyota et al. (Kiyota)	5,387,545	Feb. 7, 1995 (filed Dec. 12, 1991)
Zhang et al. (Zhang)	5,424,244	Jun. 13, 1995 (filed Nov. 4, 1992)

The appealed claims stand rejected under 35 U.S.C. § 103 as follows:

a) Claims 4, 47, 48, 50-52 and 54 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Kiyota in view of Melas.

b) Claim 49 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Kiyota in view of Melas, Bohling and Zhang.

Rather than reiterate the examiner's full statement of the above-noted rejections and the conflicting viewpoints advanced by the examiner and appellant regarding those rejections, we make reference to the examiner's answer (Paper No. 34) for the examiner's reasoning in support of the rejections, and appellant's brief and reply brief (Paper No. 33 and Paper
No. 35, respectively) for appellant's arguments thereagainst.

On page 4 of the brief, appellant indicated that claims 4, 47, 48, 50-52 and 54 stand or fall together and that claim 49 stands or falls alone. In keeping with appellant's groupings, we hereby select claims 4 and 49 from the separate rejections for review, and we shall decide the appeal as to the respective grounds of rejection on the basis of these selected claims;
37 CFR § 1.192 (c)(7).

OPINION

In reaching our decision in this appeal, we have given careful consideration to appellant's specification and claims, to the applied prior art references, and to the respective positions articulated by appellant and the examiner. As a consequence of our review, we have made the determinations which follow.

We will not sustain the examiner's rejection of claims 4, 47, 48, 50-52 and 54 under 35 U.S.C. § 103(a). Likewise, it follows that we also will not sustain the examiner's rejection of claim 49 under 35 U.S.C. § 103(a).

We first consider the rejection of claims 4, 47, 48, 50-52 and 54 under 35 U.S.C. § 103(a). The examiner (Answer, page 4) basically relies on Kiyota for teaching all of the features of independent claim 4 except for the use of an organic compound of a dopant species. The examiner points to Melas for its teaching of using an organic compound of a dopant species for doping a semiconductor wafer. From there, the examiner reasons that it would have been obvious to one of ordinary skill in the art at the time the invention was made to use a dopant species as taught by Melas in Kiyota's direct

doping process because the dopant species are conventional dopant sources during gas phase doping.

The appellant responds to the rejection of page 6 of the brief by indicating that the examiner's proposed combination of teachings is improper. In support thereof, the appellant notes that Melas teaches a chemical vapor deposition method which is not a direct doping method as required by the claims. The examiner did not present any specific arguments addressing the above-noted argument by the appellant. The appellant followed-up with a reply brief reiterating the objection to the examiner's combination of prior art teachings.

Based on the record before us, we are in general agreement with the appellant that the collective evidence relied upon and the level of skill in the particular art would not have suggested to one of ordinary skill in the art the obviousness of the invention as set forth in claims 4, 47, 48, 50-52 and 54. Although Melas (col. 1, lines 14-25) does teach doping a semiconductor wafer and the use of an organic compound of a dopant species containing $(CH_3)_3B$ and $(C_2H_5)_3B$, Melas teaches in column 6, lines 1-5 that these materials are

used in a metal organic chemical vapor deposition (MOCVD)process. Melas fails to teach or suggest that these materials are used in any other processes other than MOCVD for fabricating a semiconductor wafer or that these materials offer any benefit that is independent of the MOCVD process and could be carried over into other processes of fabricating semiconductor wafers. Furthermore, we find that the examiner has failed to substantiate the allegation that the dopant species taught by Melas are conventional dopant sources used in a gas phase doping process.

Accordingly, we find that the examiner's rejection fails to point to some teaching, suggestion, or motivation found either in the prior art relied upon or in knowledge generally available to one of ordinary skill in the art that would support using an organic compound like that taught by Melas in place of the compound taught by Kiyota for directly doping a semiconductor wafer. In re Fine, 837 F.2d 1071, 1074; 5 USPQ2d 1596, 1598 (Fed. Cir. 1988); In re Jones, 958 F.2d 347, 351; 21 USPQ2d 1941,
1943-44 (Fed. Cir. 1992).

Turning now to the rejection of claim 49, the examiner asserts at page 4 of the answer that "Zhang (col. 4, lines 52-61) teaches to use an organic compound of a dopant species, and Bohling (col. 10, lines 13-38 and col. 19, lines 33-56) teaches to use organic compounds of dopant species with a halogen species for diffusion."

At page 5 of the answer, the examiner derives therefrom that "[i]t would have been obvious to one of ordinary skill in the art at the time the invention was made to use dopant species as taught by Zhang and Bohling in Kiyota's process because the species are well known and conventional dopant sources during gas phase doping" (emphasis added).

In response, appellant argues at page 8 of the brief the following three points: (1) that combining Kiyota with Melas does not produce or render obvious the claimed novel doping method recited in claim 4; (2) that both Zhang and Bohling fail to teach the limitation of an organic compound comprising a halogen species in its molecular structure as required by claim 49; and (3) that Zhang teaches temperatures no higher than 550°C. We agree with the examiner that Zhang (col. 4,

lines 52-61) teaches the use of an organic compound of a dopant species in a gas phase process for doping a semiconductor wafer and that Bohling teaches the use of an organic compound of a dopant species with a halogen species for diffusion. However, the examiner's rejection of claim 49 suffers from the same deficiency mentioned above with respect to claim 4, that is, the examiner's rejection again fails to point to some teaching, suggestion, or motivation found either in the prior art relied upon or in knowledge generally available to one of ordinary skill in the art that would compel a practitioner in the art to replace the compound taught by Kiyota with the compound taught by Zhang or Bohling for directly doping a semiconductor wafer. Moreover, it appears that the examiner's obviousness rejection hinges solely on the fact that the compounds are known dopant sources and are therefore obvious. When the motivation to combine the teachings of the references is not immediately apparent, it becomes the duty of the examiner to explain why the combination of the teachings is proper. Ex parte Skinner, 2 USPQ2d 1788, 1790 (Bd. Pat. App. & Inter. 1986). We do not

believe that the examiner has properly established motivation for the suggested combination.

In summary, we will not sustain the examiner's rejection of claims 4, 47-52, and 54.

DECISION

The decision of the examiner is reversed.

REVERSED

KENNETH W. HAIRSTON Administrative Patent Judge	)	
MICHAEL R. FLEMING Administrative Patent Judge	)	BOARD OF PATENT APPEALS AND INTERFERENCES
ANITA PELLMAN GROSS Administrative Patent Judge	)	

KWH:hh

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